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EXAMINER	
HORNING, JOEL G	
ART UNIT	**PAPER NUMBER**
1712	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/590,105	EIJI, IWAMURA	
	Examiner	Art Unit	
	JOEL HORNING	1712	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *21 April 2011*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-16,18-21 and 23-30* is/are pending in the application.

4a) Of the above claim(s) *1-12 and 26-30* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *13-16,18-21 and 23-25* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *04/21/2011*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Claims 1-12 and 26-30 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim. Election was made **without** traverse in the reply filed on October 11th, 2010. Claims 13-25 are currently undergoing prosecution.

Claim Rejections - 35 USC § 102/103

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* v. *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

2. **Claims 13, 14, 18, 21 and 23** are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Iwamura II (Rev. Adv. Mater.Sci. 5 (2003) 166-170), as supplied by applicant) as evidenced by or in view of Iwamura III (Ceramic Transactions-Ceramic Nanomaterials and Nanotechnology II, Proceedings of the Symposium held at the 105th Annual Meeting of the American Ceramic Society, 27-30 April, 2003, Nashville, TN, US. Pages 139-146, as supplied by applicant).

Iwamura II teaches forming an amorphous carbon film by sputtering and afterwards supplying energy to the film by an electron beam to form graphite structure in the amorphous carbon film (abstract). The intensity of the electron beam is 3.1 uC/(sec*cm^2), which is 1.93*10^{13}e/(cm^2*sec), which is within applicant's claimed range (section 2.2). Though Iwamura II does not discuss whether its amorphous carbon films have a two phase columnar structure, it does teach that it was deposited by DC Magnetron sputtering (section 2.1).

Iwamura III teaches teaches that DC magnetron sputtered (vapor phase deposition, **claim 14**, experimental section) “amorphous carbon films can be characterized by columns with relatively high density surrounded by lower density regions. The lower density regions generally exhibit network structures...” (Introduction).

Since Iwamura II is the same person as Iwamura III and is also using amorphous carbon films, even ones that have been deposited by DC magnetron

sputtering, they will have the two phase columnar structure that is taught to be present in such amorphous carbon films.

Alternately, it would have been obvious to a person of ordinary skill in the art at the time of invention to substitute whatever structure Iwamura II actually happens to be with such a two phase columnar amorphous carbon films because that was the structure that was known to be normally found in sputtered amorphous carbon films, and the use of which would produce no more than predictable results.

Additionally, for the requirement that the graphite structures be formed at least in the second phase of the amorphous carbon structure, Iwamura II is performing the same process as applicant at the same intensities on the same structured materials as applicant, it should form graphite in the same places. When a reference discloses the limitations of a claim except for a property, and the Examiner cannot determine if the reference inherently possesses that property, the burden is shifted to Applicant/s, In re Fitzgerald 205 USPQ 594 and MPEP 2112 **(claim 13)**.

3. Iwamura III teaches using acceleration voltages of 60kV (section 2.2), which would produce and electron beam of 60KeV, far below the more than 100keV applicant describes is required for the graphite structures not to preferentially grow in the second phase (page 12, lines 15-19). Thus it is clearly envisaged that in the process of Iwamura III, the graphite will preferentially grow in the second phase and thus have a higher volumetric concentration in the second phase **(claims 18 and 21).**

4. Regarding **claim 23** according to Iwamura III the second phases normally exhibit network structures (introduction), so it is either inherent in or obvious for the amorphous carbon film to form a network between the first phases **(claim 23)**.

Claim Rejections - 35 USC § 103

5. **Claims 13-16, 18-21, 23 and 24** are rejected under 35 U.S.C. 103(a) as being unpatentable over Iwamura I (US 20020061397) as evidenced by applicant's specification.

Iwamura I teaches a method for forming an amorphous carbon thin film layer on a substrate. This amorphous carbon layer is supplied with energy by irradiating it with an electron beam in order to form onion-like carbon structures in the amorphous carbon [0021]. These onion-like structures are also known as onion-like graphite, since they are made from graphite [0005]. Iwamura does not teach the morphology of its amorphous carbon film, so it does not teach that it has columnar first phases and second phases intervening between them.

According to applicant's specification, in order to form an amorphous carbon two phase structure with the first structure being columnar and the second phase surrounding it like a network, what is preferably used (though applicant discloses it will form outside these ranges) is a sputtering process where at least one of the following conditions is fulfilled: the substrate is preferably less than 500°C and the chamber pressure is preferably 10mTorr or more (page 10, lines 2-27).

Iwamura further teaches that the amorphous carbon film is grown by a vapor phase process **(claim 14)**, specifically a sputtering method [0041], where the

pressure ranges used overlaps with applicant's described range and the substrate is not taught to be heated, so it is clearly envisaged to be at room temperature and certainly below 500°C. This even more clearly is the case since applicant teaches that if higher temperatures are used, it is difficult to make amorphous carbon films (page 10, lines 9-12) **(claim 15)** and Iwamura is producing amorphous carbon.

Thus, it is readily apparent that the manner and conditions taught by Iwamura for forming an amorphous film are what applicant discloses will form the claimed two phase film structure with the first phase being columnar and the second phase being a network between the first phases **(claim 23).**

Regarding the requirement that the graphite structure be formed in the second phase by supplying energy to the amorphous carbon film, Iwamura I teaches that it was known to the art and effective at forming such graphite particles in the amorphous carbon film to do just that: take a previously formed amorphous carbon film and then irradiate it in order to form graphite structures [0024].

Thus it would have been obvious to a person of ordinary skill in the art at the time of invention to form the amorphous graphite layer first and afterwards irradiate it in order to form the graphitic material in the amorphous carbon since it was known to the art to be suitable for forming graphitic material in these amorphous carbon films and would produce no more than the predictable effects of doing so.

Iwamura I further teaches that a practitioner will choose an "appropriate flux" of the electron beam in order to create the graphite structures [0021], but does not teach what the appropriate flux would be to form these graphitic structures.

It would have been obvious to one of ordinary skill in the art at the time of invention to choose the instantly claimed ranges of "$1x10^{17}e/cm^2sec$ or less" through process optimization, since it has been held that when the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. See In re Boesch, 205 USPQ 215 (CCPA 1980)**(claim 13)**.

6. Regarding **claim 16**, Iwamura teaches depositing nitrogen along with the carbon, and since the process is a vapor phase process, the nitrogen must come from a nitrogen gas in the processing gas atmosphere [0027].
7. Regarding **claims 18 and 21**, Iwamura teaches using acceleration voltages of 200V or less [0042], which would produce and electron beam of, for example, 200eV or less, far below the more than 100keV applicant describes is required for the graphite structures not to preferentially grow in the second phase (page 12, lines 15-19). Thus it is clearly envisaged that in the process of Iwamura, the graphite will preferentially grow in the second phase and thus have a higher volumetric concentration in the second phase.
8. Regarding **claim 19**, according to applicant, when the film is formed as previously described by applicant and performed by Iwamura, the second phase will normally have a lower density than the first phase (page 11, lines 19-22). Thus it is clearly envisaged that the claimed result of a lower density in the second phase than in the first phase inherently flows from the process of Iwamura. Additionally, as discussed above, since the graphite preferentially grows in the second phase, it is apparent

that it is easier to change the structure of the second phase than the first phase, otherwise the growth would not be preferential.

9. Regarding **claim 20**, Iwamura teaches that the practitioner will choose how much of the film to convert to the graphite phase, particularly teaching making 50% *or more* of the film structure into the graphite phase [0028]. According to applicant, the reversal in density so that the second phase is more dense than the first is a result that flows from converting enough of the film into the graphite material with, as previously discussed, the second phase being preferentially converted (page 13, lines 6-11).

Thus, since it is taught to convert 50% *or more* of the film into the graphite phase, it is readily apparent that starting at some minimum percentage of conversion in the process taught by Iwamura the second phase density will start being higher than the first phase and thus this claimed feature will result.

When a reference discloses the limitations of a claim except for a property, and the Examiner cannot determine if the reference inherently possesses that property (in this case, that the density of the second phase becomes greater than the first when the film is converted up to the degrees taught by Iwamura), the burden is shifted to Applicant(s). In re Fitzgerald, USPQ 594 and MPEP §2112 **(claim 20)**.

10. Regarding **claim 24**, Iwamura I teaches only exposing a region to the electron beam, which results in only converting the exposed area to the graphite phase [0005].

11. **Claims 24 and 25** are rejected under 35 U.S.C. 103(a) as being unpatentable over Iwamura I (US 20020061397) in view of Tanaka (US 6251522).

12. Regarding **claims 24 and 25**, though Iwamura teaches only exposing a portion of the amorphous film to the electron beam, it teaches using the focused beam of an transmission electron microscope to do so [0021]. It does not teach using a mask to limit the exposure to the beam.

However, Tanaka also teaches that it is desirable to control the location of the graphite structures so as to form a pattern (col 5, lines 15-21) and that one way to control exposure of the substrate surface to an energy beam is by placing a mask on the amorphous carbon surface and irradiating the surface through that so only the exposed areas are irradiated by the beam (col 4, lines 50-65).

Thus it would have been obvious to a person of ordinary skill in the art at the time of invention to pattern the regions of the amorphous carbon film so that only certain regions have been converted to the graphite phase since it was known to be desirable to produce patterns of regions that have been converted to the graphite structure and to do so by the method taught by Iwamura of exposing only the regions that are desired to be converted to the graphite phase to the electron beam **(claim 24)** and further to limit exposure to the beam by applying a mask to the surface of the graphite substrate since that was a known method to limit exposure of an amorphous carbon surface to energy beams which would produce no more than predictable results **(claim 25)**.

13. **Claims 13-16, 18, 19, 21, 23 and 24** are alternately rejected under 35 U.S.C. 103(a) as being unpatentable over Iwamura I (US 20020061397) as discussed previously in view of '632 (JP-2004-261632, from the English machine translation).

This rejection is the same as the previous Iwamura I rejection, but provides a particular motivation for a practitioner to have applicant's claimed two phase structure in the amorphous carbon film.

As discussed previously, Iwamura I teaches the claimed processing steps and growing the amorphous carbon film by a vapor phase process, specifically a sputtering method [0041]. Iwamura I further teaches that the graphite structures it produces in an amorphous carbon film are very useful for the trapping of hydrogen atoms [0005], but does not teach if the resulting morphology of its amorphous carbon film gas has columnar first phases and second phases intervening between them.

'632 is also directed towards the formation of amorphous carbon films used for trapping hydrogen [0001]. It teaches that a normal structure for the amorphous carbon film is as seen in figure 1, where there is a columnar first phase **2** and a network-like second phase **4** that surrounds the first phase [0014] **(claim 23)**. This structure is particularly desirable for the formation of hydrogen trapping devices because the second phase has a lower density than the first phase **(claim 19)** and so the hydrogen can more easily be moved into the hydrogen storage medium thus making the hydrogen absorption occur more rapidly [0021-0023].

Thus it would have been obvious to a person of ordinary skill in the art at the time of invention to utilize the amorphous carbon structure of '632 in the process of Iwamura in order to increase the hydrogen trapping speed of the device **(claim 13)**.

'632 further teaches that this structure is formed by a vapor deposition method **(claim 14)** where pressures and temperatures are the same as claimed by applicant **(claim 15)**[0027-0029].

Claims 16, 18, 21 and 24 are rejected again for the same reasons they were previously, but now in view of '632.

14. **Claims 24 and 25** are alternately rejected under 35 U.S.C. 103(a) as being unpatentable over Iwamura I (US 20020061397) as discussed previously in view of '632 (JP-2004-261632, from the English machine translation) as applied to claim 13 further in view of Tanaka (US 6251522).

These claims are rejected again for the same reasons they were previously, but now in view of '632.

Response to Arguments

15. Applicant's arguments with respect to **claims 13-16, 18-21 and 23-25** have been considered but are not convincing in view of the new ground(s) of rejection necessitated by amendment and the IDS.

16. Applicant first argues that the newly amended features of the claims overcome the art. These limitations have been considered in the rejection above.

Applicant then argues that though Iwamura I teaches using pressures that overlap with applicant's claimed ranges, the examples are not within applicant's

preferred, but not required by any claim, ranges. According to applicant's specification, in order to form an amorphous carbon two phase structure with the first structure being columnar and the second phase surrounding it like a network, what is preferably used (though applicant discloses it will form outside these ranges) is a sputtering process where at least one of the following conditions is fulfilled: the substrate is preferably less than 500°C and the chamber pressure is preferably 10mTorr or more (page 10, lines 2-27). Furthermore, from the newly supplied Iwamura III reference, it is taught that applicant's claimed columnar and networking phases is the normal structure of such sputtered amorphous carbon films (Iwamura III, introduction), so this does not appear to be a distinguishing feature. The argument is not convincing.

Regarding the new requirement for a lower beam flux. As shown in the newly supplied Iwamura II reference, beam intensities two orders of magnitude below applicant's claimed maximum intensity ($1.93*10^{13}e/(cm^2*sec)$), is also capable of forming graphite structures within the amorphous carbon. Unlike Iwamura I, Tanaka particular process requires that the electron beam be intense enough to pass though one entire carbon film **3** while still maintaining sufficient intensity to cause the graphitic phases to form, so it is expected that higher intensities would be required in the Tanaka process. A practitioner is thus highly motivated to determine which electron beam intensities will be optimal for his/her process.

Applicant then argues that claim 20 when rejected using the '632 reference, is contrary to the motivating purpose of making a hydrogen storage medium because

the easy gas flow paths would be blocked when the density of the networking phase is increase to above that of the columnar phase. This rejection of claim 20 is withdrawn. However, claim 20 is still properly rejected under other bases.

Conclusion

17. No current claims are allowed.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JOEL HORNING whose telephone number is (571)270-5357. The examiner can normally be reached on M-F 9-5pm with alternating Fridays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael B. Cleveland can be reached on (571)272-1418. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/J. H./
Examiner, Art Unit 1712

/David Turocy/
Primary Examiner, Art Unit 1717